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STRUCTURAL CHANGE IN OECD COUNTRIES: A NORMAL PATTERN ANALYSIS

BY

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1 INTRODUCTION

Economic development is strongly connected with structural change: structural change is the vehicle of economic growth and economic growth induces structural change.

Regularities in this process can be detected when one studies the development of sector shares against the background of growing *per capita* income and some other key variables. Pioneering research in this field of economic analysis has been performed by Clark (1957), Kuznets (1956/67, 1971) and Maizels (1963). Their approach, formalised and extended by Chenery (1960), Chenery and Taylor (1968), and Chenery and Syrguin (1975), renders the so-called development pattern or normal pattern for the dynamic composition of a country's prosperity.

The basic argument for the approach under consideration is that the observed cross-sectional relationship between sector shares and *per capita* income reflects the ultimate influence of the general forces, which in a broad economic analysis emerge as evidently relevant for the exploration of sectoral shifts. *Per capita* income serves as an index of overall social and economic development. From economic theory as well as from factual economics it is known that preferences, technology and comparative advantages are systematic functions of this index. The estimated income elasticity of a sector's production or employment share accounts for both supply and demand conditions common to all countries at a given stage of economic development.

As far as the actual growth path of an individual country deviates from that predicted by the normal pattern, this is due to the specific characteristics of the country concerned. Fels *et al.* (1971, 1978) are reasoning along these lines when evaluating the structural performance of the German economy during the 1960's and the early 1970's.

From a methodological point of view the normal pattern can only be considered as a useful tool of empirical analysis if two conditions are satisfied. One refers to the fact that the country-specific factors should not predominate, the

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other requires that the cross-section pattern must show a certain stability over time. These two problems of correspondence between intercountry patterns for a certain year and intertemporal patterns for a certain country have given rise to many controversial discussions. Part of the debate, sometimes labeled as the Kuznets-Chenery controversy, has been summarized in Van Gemert (1985).

The purpose of this paper is three-fold. In section 2 I propose a way to incorporate some recent views on the homogeneity and stability issue into the normal pattern concept. The model presented is used to give a general picture of the long-term dynamics of the economic structure of an industrialized market economy. In section 3 two particular events within the postwar OECD area will be emphasized. One is the persistent stagnation of economic growth since 1974; the other is the discovery and exploitation of substantial oil and gas resources in a number of western countries. The hypotheses to be tested in this context are new as far as the normal pattern's tradition is concerned. Section 4 is dedicated to the impact of specific factors in Western Europe, North America and Japan. Finally, in section 5 some concluding remarks will be made.

2 PATTERNS OF STRUCTURAL CHANGE IN THE POSTWAR OECD AREA AS A WHOLE

2.1 *The Model*

On a sectoral level economic growth is unbalanced or nonproportionate. Some sectors expand, other contract. The speed of development differs from one activity to another and varies over time. Consequently the composition of both output and employment is continuously shifting. Empirical evidence about the 'stylized facts' (Chenery) accompanying this process of structural change can be obtained by the construction of a normal pattern.

The method to be followed here urges for an *a priori* choice with respect to both the sample size and the specification of the regression equation. Batchelor (1980) has proposed not to search for 'laws of growth applicable in every corner of the world' but to look for 'identifiable groups of countries for which valid generalisations can be framed...' (p. 110). In this paper it will be assumed that the OECD area form a homogeneous sample on that score. Secondly, Gregory and Griffin (1974) argue not to rely on a single cross-section but on a combined cross-section/time-series analysis which allows for intercept differences. Following their advice the regressions in this paper are based on a pool of 18 cross-sections, while the inclusion of intercept differences regards both the international and the intertemporal dimension of that pool. Critical examinations of Jameson (1982) do in fact confirm the necessity to accept this kind of concession to the original idea of the economic structure being a universal and timeless function of only *per capita* income.[1]

1 Jameson (1982) is very resolute in rejecting the assumption of homogeneous patterns of development. In our opinion his negative view is at least partly due to the fact that the existence of both 'normal' and 'country-specific' deviations are neglected.

The equation to be estimated by OLS is uniform for each sector share z_i and has the following double logarithmic form:

$$lnz_i = \alpha_1 + \alpha_2 lny + \alpha_3 (lny)^2 + \alpha_4 lnp + \alpha_5 lnq + \alpha_6 t + v$$

in which

z_i = contribution of sector i to total value added in constant prices or to total employment
y = *per capita* GDP in US dollars (1975 prices and exchange rates)
p = population size (country mean for the observation period)
q = export/GDP-ratio (idem, current prices).
t = year index (1961 = 1)
v = error term.

The sample covers 19 countries; the period of observation is 18 years. More technical and data-related information is given in section 2.2.

The double-log quadratic functional form as adopted in this paper is not unusual; it is supported in the literature by both theoretical considerations and empirical results.[2] Given this formulation, given also the way p, q and t are defined, the regression model has some analytically convenient properties:

- The explanatory variable y is the only regressor which takes different values for each year and for each country. The 'pooled' income elasticity (ζ) follows from:

$$\zeta = \frac{\partial lnz}{\partial lny} = \alpha_2 + 2\alpha_3 lny$$

  The parameter ζ is a variable in y which allows for an increasing or decreasing, positive, negative or reversible 'rhythm of growth.' A reversible process means that a sector share initially increases but beyond a certain level of development decreases. The implied maximum is reached for $lny = \alpha_2/(-2\alpha_3)$, with $\alpha_2 > 0$ and $\alpha_3 < 0$.
- The intercept A for the cross-section in year t equals

$$A_t = \alpha_1 + \alpha_6 t$$

  The regressor t captures the income independent but systematic change of sector shares in the course of time.

2 In Chenery and Syrguin a semilog formulation was prefered because of its adding-up property. Although the double-log specification does not automatically retain the sum of the estimated sector shares equal to 100%, from our analysis this condition turned out to be met sufficiently. Another interesting contribution to the problem of assessing an adequate functional form has been given by Gemmell (1982) in presenting an alternative model where nonuniform intersectoral relations are examined directly. For such an intersectoral approach one is also referred to Scheper and Reichenbach (1973) and Muller (1980).

– The intercept B corresponding to the normal pattern of country j equals

$$B_j = \alpha_1 + \alpha_4 \, lnp + \alpha_5 \, lnq$$

The variables p (as an indicator of the size of the domestic market) and q (as an indicator of the openness of the economy) jointly measure that part of the normal specialisation pattern which is of a more static nature. Their influence through time has been excluded by definition, which is justified by the knowledge that most of the variation of the two scale variables is among countries.

2.2 *Regression Results*

A systematic treatment of the many statistical and econometric problems related to a comprehensive cross-country study like ours will not be given here.[3] In this section we shall confine ourselves to a brief discussion of the regression results obtained with the model just introduced. In the Tables 1–4 the OLS estimators of all coefficients (t-ratio's in parentheses), the adjusted coefficient of determination $\bar{R}^2$, an F-statistic on the cross-section stability (see below) and the number of observations N are presented.

The pooled regression model is based on 19 countries (all OECD countries except New Zealand, Iceland, Ireland, Luxembourg, Switzerland and Yugoslavia, which were excluded for data reasons) and 18 years (1962–1980). For these 19 countries time series were not always complete, so N never equals 342. With regard to the real production structure (Tables 2 and 4) both the numerator and the denominator of the sector shares are expressed in constant prices of 1975. The employment structure is defined in terms of 'civilian employment' (Table 1) or 'wage earners and salaried employees' (Table 3). The activities of the seven subsectors (Tables 3 and 4) are not related to total but to manufacturing output and employment respectively. Primary data are derived from the National Accounts and the Labour Force Statistics, published yearly by the OECD. Incidentally, figures from Eurostat are used to cover a gap.

Three aspects of the regression results need to be pointed out explicitly. One is the significance of the income elasticity, the other is the issue of international homogeneity and the last refers to that of intertemporal stability.

1. In most cases both $\hat{\alpha}_2$ and $\hat{\alpha}_3$ significantly differ from zero. In other cases the hypothesis $\alpha_2 = \alpha_3 = 0$ could be rejected by an F-test on the residual sum of squares of the original and the restricted model. It can be stated as a general conclusion that the sectoral income elasticities are changing during the process of normal economic development.
2. Although on *a priori* grounds the country sample was confined to the OECD area, intercept differences between *individual countries* have to be taken into account. The set of intercepts – modeled as a function of the size of the internal

3 Those interested may find a lot of information in Chenery and Syrguin (1975, pp. 141–215).

TABLE 1 REGRESSION RESULTS FOR THE EMPLOYMENT SHARES OF EIGHT SECTORS

Sector	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\alpha}_3$	$\hat{\alpha}_4$	$\hat{\alpha}_5$	$\hat{\alpha}_6$	$\bar{R}^2$	F	N
Agriculture	−2.22	2.79	−0.226	−0.37	−0.65	−0.0091	0.77	0.03	337
	(−0.7)	(3.6)	(−4.7)	(−13.4)	(−10.3)	(−2.0)			
Mining, public utility	−11.18	2.51	−0.151	0.18	0.25	−0.0029	0.26	0.37	296
	(−3.8)	(3.3)	(−3.2)	(6.1)	(3.8)	(−0.6)			
Manufacturing	−13.93	4.01	−0.242	0.11	0.28	−0.0060	0.80	0.18	277
	(−12.0)	(13.5)	(−12.9)	(9.3)	(10.6)	(−3.2)			
Construction	−16.97	4.77	−0.292	−0.02	0.11	0.0046	0.72	0.44	306
	(−15.5)	(17.1)	(−16.6)	(−2.1)	(4.7)	(2.7)			
Wholesale, retail trade	−10.80	3.03	−0.175	0.04	−0.03	0.0051	0.65	0.59	274
	(−8.2)	(9.1)	(−8.5)	(4.4)	(−1.6)	(3.6)			
Transport, communication	−11.10	3.17	−0.182	−0.09	−0.08	−0.0030	0.78	0.46	305
	(−13.2)	(14.8)	(−13.5)	(−10.7)	(−4.5)	(−2.2)			
Finance, business services	0.30	−0.67	0.083	0.07	0.02	0.0144	0.80	0.51	279
	(0.2)	(−1.4)	(2.7)	(3.7)	(0.5)	(4.7)			
Social services	4.10	−0.76	0.069	0.05	0.15	0.0079	0.73	0.62	279
	(2.9)	(−2.1)	(3.0)	(3.8)	(5.1)	(3.5)			

TABLE 2 – REGRESSION RESULTS FOR THE REAL PRODUCTION SHARES OF EIGHT SECTORS

Sector	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\alpha}_3$	$\hat{\alpha}_4$	$\hat{\alpha}_5$	$\hat{\alpha}_6$	$\bar{R}^2$	F	N
Agriculture	8.05	−0.07	−0.038	−0.39	−0.59	−0.0024	0.87	0.07	318
	(4.2)	(−0.1)	(−1.2)	(−21.8)	(−14.8)	(−0.8)			
Mining, public utility	−3.78	0.81	−0.041	0.13	0.17	0.0086	0.26	0.36	318
	(−1.5)	(1.3)	(−1.0)	(5.8)	(3.2)	(2.2)			
Manufacturing	−3.05	1.35	−0.083	0.11	0.23	0.0100	0.48	0.34	318
	(−2.6)	(4.5)	(−4.4)	(10.3)	(9.4)	(5.4)			
Construction	−12.31	3.81	−0.235	−0.09	−0.05	−0.0107	0.57	0.75	318
	(−11.6)	(14.0)	(−13.7)	(−9.1)	(−2.3)	(−6.4)			
Wholesale, retail trade	−4.72	1.85	−0.111	−0.08	−0.24	0.0020	0.33	0.16	300
	(−4.8)	(7.3)	(−7.0)	(−8.5)	(−11.6)	(1.3)			
Transport, communication	6.55	−1.00	0.065	−0.09	0.04	0.0068	0.28	0.42	318
	(4.1)	(−2.5)	(2.5)	(−6.0)	(1.1)	(2.7)			
Finance, business services	−3.04	0.93	−0.033	−0.05	−0.36	−0.0071	0.71	0.37	300
	(−2.6)	(3.1)	(−1.7)	(−5.0)	(−14.7)	(−3.8)			
Social services	0.57	0.44	−0.023	0.08	0.19	−0.0059	0.55	0.38	300
	(0.6)	(1.9)	(−1.5)	(9.7)	(10.1)	(−4.1)			

TABLE 3 – REGRESSION RESULTS FOR THE EMPLOYMENT SHARES OF SEVEN SUBSECTORS

Subsector	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\alpha}_3$	$\hat{\alpha}_4$	$\hat{\alpha}_5$	$\hat{\alpha}_6$	$\bar{R}^2$	F	N
Food, beverage, tobacco	−0.93	1.21	−0.071	−0.20	−0.20	−0.0066	0.41	0.26	297
	(−0.3)	(1.8)	(−1.7)	(−13.2)	(−5.8)	(−2.4)			
Textile, leather	−6.23	2.86	−0.213	0.00	0.01	0.0001	0.68	0.63	301
	(−2.3)	(4.3)	(−5.1)	(0.1)	(0.2)	(0.0)			
Wood, construction products	10.90	−1.60	0.088	−0.14	−0.08	0.0051	0.49	0.28	292
	(4.7)	(−2.8)	(2.5)	(−10.9)	(−2.9)	(2.2)			
Paper, printing	2.39	−0.28	0.051	−0.16	−0.16	−0.0225	0.59	0.12	294
	(0.8)	(−0.4)	(1.1)	(−8.8)	(−3.9)	(−7.1)			
Chemicals	−5.73	1.71	−0.104	0.09	0.07	0.0160	0.42	0.48	301
	(−3.3)	(3.9)	(−3.9)	(8.3)	(3.1)	(8.6)			
Basic metal	−25.85	6.05	−0.359	0.21	0.11	0.0167	0.34	0.30	248
	(−4.4)	(4.1)	(−3.9)	(6.2)	(1.5)	(2.6)			
Metal products	2.92	−0.41	0.043	0.14	0.15	−0.0064	0.74	0.35	258
	(1.8)	(−1.0)	(1.7)	(14.5)	(7.0)	(−3.5)			

TABLE 4 – REGRESSION RESULTS FOR THE REAL PRODUCTION SHARES OF SEVEN SUBSECTORS

Subsector	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\alpha}_3$	$\hat{\alpha}_4$	$\hat{\alpha}_5$	$\hat{\alpha}_6$	$\bar{R}^2$	F	N
Food, beverage, tobacco	−2.73	1.54	−0.097	−0.05	0.06	−0.0104	0.24	0.41	242
	(−1.1)	(2.6)	(−2.6)	(−3.0)	(1.7)	(−3.8)			
Textile, leather	−22.60	7.01	−0.482	−0.00	−0.05	0.0115	0.89	0.57	232
	(−11.2)	(13.9)	(−15.4)	(0.0)	(−1.6)	(4.9)			
Wood, construction products	11.56	−1.69	0.097	−0.22	−0.19	−0.0049	0.52	0.28	242
	(4.1)	(−2.4)	(2.2)	(−11.4)	(−4.6)	(−1.5)			
Paper, printing	3.13	−0.15	0.055	−0.41	−0.50	0.0434	0.67	0.11	242
	(0.8)	(−0.2)	(0.9)	(−15.5)	(−8.8)	(−10.0)			
Chemicals	3.17	−0.41	0.014	0.21	0.39	0.0290	0.43	0.19	242
	(1.1)	(−0.6)	(0.3)	(10.8)	(9.3)	(9.0)			
Basic metal	−16.41	3.81	−0.209	0.11	−0.05	−0.0071	0.51	0.78	231
	(−4.4)	(4.1)	(−3.6)	(4.2)	(−0.8)	(−1.7)			
Metal products	12.39	−2.64	0.172	0.14	0.13	0.0019	0.61	0.46	242
	(7.7)	(−6.6)	(6.9)	(12.2)	(5.3)	(1.0)			

and the importance of the external market – is a comprehensive indicator of the static regularities in the international pattern of product specialization.[4]
3. The significance of α_6 supports the economic argument preceding the introduction of time into the model. Yet one might wonder whether or not the *individual cross sections* fit into the pooled regression equation. Such a question, referring to the issue of stability, has been investigated in several ways, one being an analysis of covariance. As proposed by Maddala (1977, Ch. 14) we shall not reject the restrictions, put on the model when cross sections are pooled, if the restricted residual sum of squares (*RRSS*) does not significantly differ from the unrestricted one (*URSS*). In order to test this hypothesis the following F-statistic has been computed for all normal patterns.

$$F = \frac{RRSS\text{-}URSS/(17 \times 5)}{URSS/(N\text{-}18 \times 5)}$$

where $(N\text{-}18 \times 5)$ accounts for the degrees of freedom when 18 cross-sections are run separately, and (17×5) for the number of restrictions when all observations are pooled. Given the cross-section parameters in for example the first year of the observation period, H_0 says that for all other years t

$$\alpha_{i,t} = \alpha_{i,t-1} \; (i = 2,...,5) \text{ and}$$

$$\alpha_{1,t} = \alpha_{1,t-1} + \alpha_6$$

As can be seen from the relevant column in Tables 1–4 F never exceeds its critical value.

2.3 *Normal Relative Growth Rates*
The specification of the normal pattern assumes structural change in the individual countries to take place at a *level* determined by all regressors, but at a *speed* determined by the income variable only.[5] The behaviour of all sector shares z_i, as they move along a systematically shifting cross section, can be presented concisely by

$$\dot{z} = \frac{\mathrm{d}\, ln\, z}{\mathrm{d}t} = \zeta \dot{y} + \alpha_6 = (\alpha_2 + 2\alpha_3\, lny)\, \dot{y} + \alpha_6$$

It appears that the normal relative growth rate of any sector share is a function of y and $\dot{y}$ only. The next four tables show the expected values for $\dot{z}$ (*per annum*

4 Moreover, since an analysis of the residuals makes clear that most countries have a systematic position on the regression surface, the experiment with the energy variable in section 3 and the introduction of country dummies in section 4 may be considered as useful extensions.

5 In section 3 this assumption is to be modified.

TABLE 5 – NORMAL RELATIVE GROWTH RATES FOR THE EMPLOYMENT SHARES OF EIGHT SECTORS

	$\dot{y} = 2\%$			$\dot{y} = 4\%$		
Sector	$y=2000$	$y=5000$	$y=8000$	$y=2000$	$y=5000$	$y=8000$
Agriculture	−2.2	−3.0	−3.5	−3.5	−5.2	−6.0
Mining, public utility	0.1	−0.4	−0.7	0.5	−0.6	−1.1
Manufacturing	0.1	−0.8	−1.3	0.8	−1.0	−1.9
Construction	1.1	0.1	−0.5	1.8	−0.4	−1.5
Wholesale, retail trade	1.3	0.6	0.3	2.0	0.7	0.1
Transport, communication	0.5	−0.2	−0.5	1.3	−0.0	−0.7
Finance, business services	2.6	2.9	3.1	3.8	4.4	4.7
Social services	1.4	1.6	1.8	2.0	2.5	2.8

percentages) differentiating between three levels and two growth rates of macroeconomic development.[6] The figures enable us to discuss the dominant features of structural change in the post-war OECD area as a whole.

As to the *composition of employment* (Table 5) structural change in the low-income countries implies a huge reallocation of labour from agricultural activities to construction and to services. The employment share of the manufacturing sector is nearly constant. For higher income countries, however, the picture is different. Not only the primary but also the secondary sector as a whole is diminishing its contribution to the absorption of the labour supply. Maximum levels of this relative contribution of the secondary sector are attained at a *per capita* income of approximately $ 4000. Thus the generalisation made by Clark (1957, p. 492) still seems valid: 'A wide simple and far-reaching generalisation in this field is to the effect that, as time goes on and communities become more economically advanced, the numbers engaged in agriculture tend to decline relative to the numbers engaged in services.' Even when the USA became 'world's first service economy' (Fuchs, 1968) by reaching a 55% employment share for tertiary activities (excluding transport and communication) long-term tendencies did not stop. On the contrary, in the early 1980's six other OECD countries had already followed this American example. Within the service sector (as can also be seen from Table 1) especially finance, business services and social or community services prove to be important places of job creation. The speed of all these redistributional processes is strongly connected with the overall rate of economic growth ($\dot{y}$).

6 The sum of all sector shares (and also that of all subsector shares) equals 100%. Consequently the weighted sum of all (sub)sectoral relative growth rates amounts to zero. This should hold for each y and $\dot{y}$, a restriction related to the adding up condition mentioned in note 2.

TABLE 6 – NORMAL RELATIVE GROWTH RATES FOR THE REAL PRODUCTION SHARES OF EIGHT SECTORS

	$\dot{y} = 2\%$			$\dot{y} = 4\%$		
Sector	$y=2000$	$y=5000$	$y=8000$	$y=2000$	$y=5000$	$y=8000$
Agriculture	−1.5	−1.7	−1.7	−2.8	−3.1	−3.2
Mining, public utility	1.2	1.1	1.0	1.6	1.3	1.2
Manufacturing	1.2	0.9	0.7	1.3	0.7	0.4
Construction	−0.6	−1.5	−1.9	−0.2	−1.9	−2.8
Wholesale, retail trade	0.5	0.1	−0.1	0.9	0.1	−0.4
Transport, communication	0.7	0.9	1.0	0.6	1.1	1.4
Finance, business services	0.1	0	0	1.0	0.8	0.7
Social services	−0.4	−0.5	−0.5	−0.2	−0.4	−0.5

The *transformation of real output* (Table 6) is not similar to the reallocation of labour inputs.[7] Most striking perhaps is the observation that the contribution of the manufacturing sector increases not only when *per capita* income is low but also when a country's prosperity is already high. Complementary to this it is found that the supply of social services (measured as a volume according to the conventional accounting procedures) does not exceed previous proportions. One might say that the general factors as conceived by the normal pattern do not exhibit a process of de-industrialization. On the contrary the general behaviour of the economic structure is still one of industrial expansion. Manufacturing plays an important role which is ever increasing. This sector is not only responsible for the delivery of many consumption goods and exportables, but should also be recognized as the main 'place of origin' with respect to new and advanced investment goods and intermediate products as well as the main 'locus of current technological innovation' (Kuznets). At the same time however it is interesting to see how some segments of the tertiary sector show normal growth rates which resemble very much those of manufacturing at earlier stages of development. For transport and communication this phenomenon of 'industrialization within the service sector' is very clear. A reversal of the employment share takes place at an expected income level of $ 4500 (for manufacturing the corresponding level is $ 2700), while the contribution to

7 In Van Gemert (1985) the behaviour of the production structure in *current* prices has been investigated too. It appears that normal growth rates of these sector shares resemble very much those of the employment shares. This empirical finding supports the well-known theoretical inference made by Baumol (1967) in his world of unbalanced productivity growth. In sectors where labour productivity increases are relatively high, relative prices stay behind and *vice versa*.

total production continues to increase rather fast. Consequently the growth of labour productivity in this type of service is comparable to that of manufacturing and agriculture. Presumably, the lasting improvement of labour efficiency in increasing parts of the economy, combined with the pressure of relative demand in favour of 'industrialized' services and 'high tech' goods, represents a powerful mechanism behind the long-term dynamics of structural change.

Capital accumulation, modernization of production processes and the introduction of new goods may represent systematic forces behind the general tendencies for the *seven subsectors* (Tables 7 and 8). Economic development consists in a subsequent rise and decline of industrial products. Chenery and Tay-

TABLE 7 – NORMAL RELATIVE GROWTH RATES FOR THE EMPLOYMENT SHARES OF SEVEN MANUFACTURING SUBSECTORS

	$\dot{y} = 2\%$			$\dot{y} = 4\%$		
Subsector	$y=2000$	$y=5000$	$y=8000$	$y=2000$	$y=5000$	$y=8000$
Food, beverage, tobacco	−0.4	−0.7	−0.8	−0.1	−0.6	−0.9
Textile, leather	−0.7	−1.5	−1.9	−1.5	−3.1	−3.9
Wood, construction products	−0	0.3	0.5	−0.6	0.1	0.4
Paper, printing	−1.3	−1.1	−1.0	−0.3	0.1	0.3
Chemicals	1.8	1.5	1.3	2.1	1.3	0.9
Basic metal	2.9	1.5	0.9	4.1	1.4	0.1
Metal products	−0.2	−0	0.1	0.3	0.6	0.8

TABLE 8 – NORMAL RELATIVE GROWTH RATES OF THE REAL PRODUCTION SHARES OF SEVEN MANUFACTURING SUBSECTORS

	$\dot{y} = 2\%$			$\dot{y} = 4\%$		
Subsector	$y=2000$	$y=5000$	$y=8000$	$y=2000$	$y=5000$	$y=8000$
Food, beverage, tobacco	−0.9	−1.3	−1.4	−0.8	−1.5	−1.9
Textile, leather	0.5	−1.3	−2.2	−0.1	−3.7	−5.5
Wood, construction products	−0.9	−0.6	−0.4	−1.4	−0.7	−0.3
Paper, printing	−3.0	−2.8	−2.7	−1.6	−1.2	−1.0
Chemicals	2.5	2.6	2.6	2.1	2.2	2.3
Basic metal	0.6	−0.2	−0.6	1.8	0.3	−0.5
Metal products	0.1	0.8	1.1	0.1	1.3	2.0

lor clarify this observation by identifying 'early, middle and late industries.' Since the level of abstraction in our analysis remains rather high it is not possible to actualize this association in a responsible way. Yet the tables denote where to find the successors of past comparative advantages: the output structure moves very clearly from labour intensive to capital intensive branches. According to Freeman (1974), but also to other authors, 'invasion' of plastics, synthetics and related organic products on the one hand and electronics on the other has 'colonized' both consumers' final and traditional industries' intermediate demand. These innovations have given a very strong stimulus to the growth of chemicals and metal products especially, but not only, at the cost of textiles and leather.[8]

Not only output but also employment has shifted relatively towards the two leading subsectors of manufacturing, Apparantly, substantial relative price reductions together with high income and substitution elasticities of demand could outweigh the negative employment effect of labour rationalization. Or, to put it in terms of Verdoorn's law: the growth rate of (relative) productivity is positively related to the growth rate of (relative) output, but the corresponding elasticity is less than unity.

For the sector of fabricated metals intra-industry growth is faster whenever y and/or $\dot{y}$ is higher. The first relation indicates that rich countries take the lead in the continuous modernization of output. The second suggests how the production of new equipment operates as an 'engine of growth,' an interpretation which emphasizes for a moment the reciprocal effect of structural change on the overall development of an economy.[9]

3 THE IMPACT OF STAGNATION AND THE ROLE OF ENERGY RESOURCES

During the 1970's the western world faced a remarkable slowdown of the average development of economic activity. In 1974 the OECD production of goods and services began to stagnate. In 1975 the volume of international trade diminished. After a while the employment situation also worsened. Disturbing factors accompanying these events were – among others – the sudden rise of energy prices, the breakdown of the monetary system of fixed exchange rates, and the process of wage inflation already started in the 1960's, especially in Europe. As Pen (1979) points out, the real nature and causes of the stagnation period are very hard to reveal. However one might wonder whether and to what extent the persistent recession in macroeconomic performances did affect the long-term paces of structural change as considered above.[10] To discuss this

8 This does not mean a complete death: new and technically advanced products from this declining industry can of course survive.

9 In this respect it is worthwhile to quote Batchelor (1980, p. 132): '... The equations used to account for structural change are condensed forms of a more complex general equilibrium model and are ambivalent as regards direction of causation.'

10 Again, there also is a causality which goes the other way round (see for instance Lindbeck, 1983).

question within the framework of the normal pattern model is one of the aims of this section.

Our second question refers to the discovery and exploitation of oil and gas resources in the Netherlands, Norway and the United Kingdom. Production of primary energy in these countries rose sharply in the late 1960's and 1970's, while it had already reached a substantial level in Australia, Canada and the United States. Recent economic theory such as presented in Barker and Brailovsky (1981) suggests that the absorption of a rent income from the extractive sector will induce a transformation of domestic production towards the non-tradeable sector. This phenomenon, usually known as the Dutch disease, will be investigated in this section too.

Analytically the two distinctions just made – the former between periods of time, the latter between groups of countries – will be elaborated by reestimating the normal pattern of structural change after introducing two new explanatory variables. This is to say that the regression equation is reformulated in the following way

$$ln\ z_i = \alpha_1 + \alpha_2 lny + \alpha_3 (lny)^2 + \alpha_4 lnp + \alpha_5 lnq + \alpha_6 t + \alpha_7 lns + \alpha_8 lnk + \alpha_9 (lnk)^2 + \upsilon$$

in which

s = rate of unemployment in the OECD as a whole (index, 1966 = 1).
k = production of primary energy (kilogram coal equivalents per capita).[11]

Of course normal growth rates $\dot{z}$ become more complex:

$$\dot{z} = \zeta \dot{y} + \alpha_6 + \alpha_7 \dot{s} + \theta \dot{k}$$

where

$$\theta = \alpha_8 + 2\alpha_9 lnk$$

For any year the recession variable s has the same value in all countries. The introduction of s implies that the income independant part of $\dot{z}$ will be no longer a constant (as in section 2) but a function of the external shocks approximated by $\dot{s}$. The estimated recession elasticities $\hat{\alpha}_7$ are presented in the first column of Table 9 (employment shares) and Table 10 (production shares). As to the variable k the specification chosen permits of a nonlinear relationship. Analogous to ζ the energy elasticity θ is a function of k. Apart from the regression

11 In accounting for a potential lag in the adjustment process of the economic structure to changing circumstances, both s and k are measured as a five-year moving average.

TABLE 9 – REGRESSION RESULTS WITH RESPECT TO THE EXTENDED MODEL (EMPLOYMENT SHARES)

	$\hat{\alpha}_7$	$\hat{\alpha}_8$	$\hat{\alpha}_9$	θ_1	θ_2	$\bar{R}^2$
Agriculture	0.09	0.50	−0.046	−0.25	−0.34	0.80
	(0.4)	(3.7)	(−4.6)			
Mining, public utility	0.46	0.13	0.005	0.22	0.23	0.48
	(2.1)	(1.1)	(0.6)			
Manufacturing	−0.15	0.22	−0.019	−0.09	−0.12	0.83
	(−1.6)	(4.2)	(−4.8)			
Chemical industries	0.07	−0.07	0.004	0	0	0.43
	(0.7)	(−1.3)	(1.0)			
Metal industries	0.04	0.21	−0.016	−0.05	−0.08	0.72
	(0.5)	(4.7)	(−4.7)			
Other manufacturing	−0.02	−0.19	0.015	0.05	0.08	0.76
	(−0.4)	(−5.4)	(5.7)			
Construction	−0.15	0.13	−0.014	−0.09	−0.11	0.77
	(−1.7)	(2.7)	(−3.8)			
Commercial services	0.13	−0.21	0.016	0.06	0.09	0.91
	(1.8)	(−5.3)	(5.7)			
Social services	0	−0.51	0.040	0.14	0.21	0.80
	(0.0)	(−8.7)	(9.3)			

coefficients $\hat{\alpha}_8$ and $\hat{\alpha}_9$ Table 9 and Table 10 therefore also show two values of the compounded parameter θ: θ_1 ($k = 3500$, being an OECD average) and θ_2 ($k = 9000$, being an average for the energy-rich countries in the late 1970's). For all $\hat{\alpha}$'s t-values are given in parentheses. The last column contains the $\bar{R}^2$ of the complete model. A number of activities within manufacturing as well as within services have been taken together in order to generalize the results.[12]

The recession was attended by a significant change in the rate of growth with respect to the production share of the investment goods sector (chemicals, metals, construction). The normal growth rate of secondary production was squeezed, whereas the sector of social services benefited from this development. One may wonder whether this result should lead to the conclusion of 1973/74 being the starting year of a new epoch of capitalist history. If so, the normal pattern approach, since it is strongly based on long-term and stable laws of development, would loose much of its power. However, generally speaking, the hypothesis of a sudden shift in structural patterns of change cannot be con-

12 First-run regressions with all 15 (sub)sectors made clear that the individual activities within the two new aggregates (other manufacturing and commercial services) behave rather *similary* in response to the new regressors.

TABLE 10 – REGRESSION RESULTS WITH RESPECT TO THE EXTENDED MODEL (REAL PRODUCTION SHARES)

	$\hat{\alpha}_7$	$\hat{\alpha}_8$	$\hat{\alpha}_9$	θ_1	θ_2	$\bar{R}^2$
Agriculture	0.16	0.18	−0.017	−0.10	−0.13	0.88
	(1.0)	(2.0)	(−2.6)			
Mining, public utility	0.16	−0.18	0.032	0.35	0.41	0.78
	(1.3)	(−2.6)	(6.6)			
Manufacturing	−0.33	0.44	−0.034	−0.11	−0.18	0.61
	(−3.7)	(8.9)	(−9.3)			
Chemical industries	−0.47	−0.08	0.009	0.06	0.08	0.46
	(−2.7)	(−0.9)	(1.3)			
Metal industries	−0.15	0.11	−0.010	−0.04	−0.06	0.69
	(−1.7)	(2.5)	(−2.8)			
Other manufacturing	0.13	−0.15	0.012	0.06	0.08	0.70
	(1.2)	(−2.8)	(3.2)			
Construction	−0.25	−0.06	−0.002	−0.08	−0.09	0.73
	(−3.5)	(−1.4)	(−0.5)			
Commercial services	0.10	−0.16	0.012	0.04	0.07	0.47
	(1.4)	(−3.8)	(4.1)			
Social services	0.19	−0.22	0.017	0.05	0.08	0.60
	(2.6)	(−5.5)	(5.6)			

firmed by the results of our experiment. Most recession elasticities – especially with respect to employment – are not significantly different from zero, while the recession-induced transformation of product just mentioned can perhaps very well be explained by the multiplier-accelerator model of the business cycle. At least at the aggregate level of this analysis and up till the early 1980's it seems acceptable to conclude that the deceleration in macroeconomic growth was not accompanied by a substantial realignment of intersectoral dynamics.[13]

Unlike the interpretation of the recession variable the experiment with the energy variable is unambiguous. The impact on the economic structure of a country's endownment with oil or natural gas is significant and clear. Firstly, the normal pattern elasticities indicate that the more a country can rely on its own energy resources the more those sectors are favoured which are involved in energy production and distribution. However, apart from this rather trivial 'primary effect,' Tables 9 and 10 also point out that such a country is inclined to expand services at the cost of manufacturing and agriculture. This observation, which could be called energy-induced 'de-tradeablization,' supports re-

13 Before having drawn this generalization not only the significance of the new regressor but also its influence on the original estimators was considered in detail.

cently developed views in this field. The two mechanisms underlying these views can be summarized as follows.

Firstly, an increase in energy production will improve the balance of payments on current account. This will lead to a real appreciation of the currency and a deterioration of the level of competitiveness. Exports will decline, import substitution will increase and the country will have to face 'de-tradeablization.' The expression 'Dutch disease' refers to this phenomenon, most probably because the Netherlands was the first country which was confronted with this problem, but also because gas production in the Netherlands is a temporary phenomenon.

The second mechanism appealing to a general equilibrium approach refers to the situation in which a country's initial surplus on the current account is offset by additional imports. Such a country can not avoid 'de-tradeablization' either. The real nature of the revenues from the extractive sector is that of a rent income which will be spent on both tradeables and nontradeables. Since only the former can be imported, the share of the latter in domestic production will show a tendency to rise. This 'expenditure effect' of energy wealth is accompanied by a change in the internal terms of trade. The relative price of the nontradeable sector will rise and so a reallocation of factors of production towards this type of activity is made possible.

In reality both the Dutch-disease model and the general-equilibrium model will play a role. Anyhow our empirical results are consistent with the line of reasoning in both models. Especially social services but also most marketable services – dominated by nontradeables – show positive energy elasticities, while agriculture and manufacturing sectors exhibit negative ones. For the construction sector where a positive effect was expected, our evidence can only be understood if this sector is considered to be highly complementary with manufacturing. Within manufacturing particularly the share of the equipment subsector is affected in a negative way. Yet, since the values of the other subsectors' elasticities do not counterbalance those of the aggregate, the *macro*economic contributions of chemicals and other manufacturing undergo contracting influences too.[14]

While energy exploitation itself is very labour extensive, the isolated meaning of the 'expenditure effect' – as distinguished from the 'primary effect' – can best be induced from Table 9. However, the figures in Table 10 also point out that spending does predominate and that the theories mentioned above are of importance not only for the employment structure but for the real production shares as well. In terms of the normal pattern approach a new general factor of structural change has been detected. Consequently the label 'disease' as well as the adjective 'Dutch' may be misleading. Energy-induced 'de-tradeablization'

14 As stated in section 2.2 the subsector shares are expressed as a proportion of manufacturing output or employment.

seems to be a normal phenomenon which to a certain extent is relevant for any country with substantial energy resources.

4 RELATIVE SPECIALIZATION PATTERNS IN THE SEVEN LARGE OECD COUNTRIES

Up to now the analysis and interpretation has been regarding the general features of the development process. However, apart from factors common to groups of countries in a certain period of history, structural change in an individual economy is also characterised by idiosyncratics. Actual *levels* of sector shares can continuously deviate from the predicted ones when a country has certain Ricardian comparative advantages such as geographical position. Actual *growth rates* may also differ from the normal ones, for instance because of a country's relative flexibility in adjusting its economic structure in accordance with the general requirements of economic growth and international trade. Both types of country-specific behaviour – the first being of a more static, the second of a more dynamic nature – can be traced by a further investigation of the residuals (grouped by country) of the OECD normal pattern. For this reason dummy variables are added to the regression equation of the extended model (f) as presented in section 3. For any sector share z_i and any country j the procedure implies a re-estimation of [15]

$$ln\, z_i = f + \beta_{j,1}\, d_{j,1} + \beta_{j,2}\, d_{j,2} + \upsilon$$

The first dummy variable of country j covers the whole observation period; the second one is defined as unity only for the years after 1973 (for all other countries $d_1 = d_2 = 0$). Consequently the coëfficient $\beta_{j,1}$ measures the average value of all residuals belonging to country j (indicating the static relative specialization of country j) while $\beta_{j,2}$ captures a potential change of this value over time (indicating roughly some dynamics of this traditional specialization). The normal pattern is thus used as a yardstick aiming at a quantification of the *level* and the divergent or convergent *development* of a country's revealed specialization structure. Since the specification of the model is double-logarithmic, the estimated β's approximate relative deviations between the realized and the normal sector shares. The average deviation during the 1960's and the 1970's is represented by $\hat{\beta}_1$; $\hat{\beta}_2$ accounts for extra divergence after 1973, so $(\hat{\beta}_1 + \hat{\beta}_2)$ approximates a relative country position reached during the late 1970's.

Some results of this experiment are shown in Table 11. The presentation of $\hat{\beta}$'s is confined to the real production structure in seven countries, as composed by six (aggregated) sectors. All production shares (including those of the chem-

15 In order to make clear what has been done exactly: in the case of $i=6$ and $j=7$ (Table 11) we ran 42 regressions yielding estimators for all coefficients, including the α's.

TABLE 11 – THE PRODUCTION STRUCTURE IN SEVEN LARGE OECD COUNTRIES (DEVIATIONS FROM THE NORMAL PATTERN)

		USA	Ca	Ja	FRG	UK	Fr	It
Agriculture	$\hat{\beta}_1$	−0.22*	0.44*	0.13(*)	−0.09	−0.68*	0.40*	0.39*
	$\hat{\beta}_2$	0.01	0.07	−0.19(*)	0.02	0.10	−0.11	−0.05
Manufacturing	$\hat{\beta}_1$	0.16*	−0.06(*)	−0.06(*)	0.28*	−0	−0.09*	−0.06*
	$\hat{\beta}_2$	−0.07	−0.02	0.08	−0.07	−0.11(*)	0.01	0.02
Chemical industry	$\hat{\beta}_1$	0.29*	−0.24*	−0.33*	0.47*	..	0.27(*)	−0.47*
	$\hat{\beta}_2$	−0.18	−0.13	0.04	−0.09		−0.03	0.07
Metal industry	$\hat{\beta}_1$	0.10	−0.08	0.38*	0.13*	..	−0.30*	−0.24*
	$\hat{\beta}_2$	−0.12	−0.02	0.05	−0.11		−0	0.03
Services	$\hat{\beta}_1$	0.01	−0.04(*)	0.06*	−0.19	0.04*	0.02	−0.04*
	$\hat{\beta}_2$	0.04(*)	−0	−0.06(*)	0.04(*)	0.04	0.02	0.01
Social services	$\hat{\beta}_1$	−0.10*	0.19*	−0.02	−0.15*	0.02	−0.01	..
	$\hat{\beta}_2$	−0	−0.01	−0.14*	0.10*	0.05	−0.03	

* = dummy variable is significant at a 95% confidence level
(*) = dummy variable is significant at a 80% confidence level
.. = no observation available.

ical and the metal industry) are defined as relative contributions to real GDP.

Of course one should bear in mind that the residuals, as in any statistical analysis, contain all kinds of specification and measurement errors. Consequently the country-dummy experiment is surrounded by big uncertainties.[16] Nevertheless some salient features from this exercise in revealed relative specialization patterns can be summarized by grouping the seven countries according to the signs of the sectoral β's into three clusters:

I United States (USA), Federal Republic of Germany (FRG)
II Canada (Ca), France (Fr), Italy (It)
III Japan (Ja), United Kingdom (UK)

Both the two countries in *cluster I* can be characterised as industrial nations, not in the absolute sense as usually understood but in the international comparative sense explained above. Manufacturing, as well as those branches which in section 2.3 turned out to be leading and fastly growing, hold dominant positions in both countries ($\hat{\beta}_1$ is significantly positive). Nevertheless part

16 These uncertainties seem greatest where conclusions are drawn from the expected values of the second dummy variable.

of this advantage has been lost during the late 1970's ($\hat{\beta}_2$ is negative). Especially the contribution of the chemical industry in the United States has suffered a lot. This deterioration has favoured the relative orientation on commercial services (USA) and social services (FRG).

The countries in *cluster II* have in common that agriculture is overrepresented: the production share is some 40% higher than one would expect on the basis of the general forces. On the other hand the relative importance of the industrial production is 6–9% less than the normal pattern predicts, while within manufacturing the picture of $\hat{\beta}_1$'s indicates a concentration on labour-intensive goods. All this idiosyncratic behaviour has not been changed very much. On the contrary, the low values of $\hat{\beta}_2$ suggest a traditional and rather stable participation in the international division of labour.

More dynamic is the development of the economic structure in *cluster III*. Structural change in Japan and the United Kingdom can both be interpreted as striking examples of the interrelationship with economic growth.[17] In Japan the normal rhythm of industrialization has been surpassed by the actual rates of restructuring the economy. The dominant position of agriculture and services in the 1950's and early 1960's has disappeared. The equipment sector served as an engine of growth; backward and forward linkages pushed *per capita* income up to growth rates far exceeding those of other OECD countries. The recent experiences in the United Kingdom can be described with the same arguments although in an opposite way. This country had to face a relative decline of the manufacturing production share ($\hat{\beta}_2$ is negative), which resulted in a gap with the normal pattern. One could call this a divergent de-industrialization, a phenomenon which was accompanied by lagging growth rates for the output and labour productivity of the total economy.

It is interesting to know the causes and nature of a country's deviation from the normal pattern. Some general suggestions have been made. More detailed hypotheses regarding a specific economy might be raised by studying the socio-economic history of the country concerned. Since the normal pattern is assumed to represent the universal engines of economic development this study has to look for idiosyncratic features and events. Perhaps it is here where quantitative and qualitative analyses should meet and where cross-country comparisons can lead on to a deeper understanding of national performances.

17 Many of the arguments which stress the importance of the manufacturing sector in explaining the overall growth performance of an economy are advocated by Cornwall (1977). His view of growth and transformation of modern capitalism essentially represents a very elegant synthesis of Chenery's development pattern (where the causation primarily runs from *per capita* income to the economic structure) and an extended Verdoorn's law (where the rate of growth of manufacturing output determines the rate of growth of productivity in manufacturing as well as in several non-manufacturing sectors).

5 CONCLUDING REMARKS

This paper is concerned with structural change in industrial countries. Its aim is to present a contribution to the investigation of the forces determining the conditions of prosperity. This has been done within the framework of a method which renders the so-called 'normal pattern' or 'development pattern' for structural change. This final section may summarize our main conclusions.

1. The basic idea of the approach is that the economic structure exhibits regularities which can be detected by studying and analysing the development of sector shares against the background of growing *per capita* income and some other key variables. This concept as it was introduced some decades ago still holds.

2. Methodologically, a specification allowing for variable intercepts (with respect to both countries and years) and variable income elasticities (with respect to the pool) makes it possible to account for the homogeneity and stability issue on an integrated level of analysis.

3. The impact of particular events within the chosen observation period and country sample can be traced out by a further extension of the original model. In this paper two hypotheses were tested. One refers to the persistent stagnation of economic growth since 1974, the other is about the discovery and exploitation of substantial oil and gas resources in a number of OECD countries. It is shown to what extent these events were accompanied by a shift of the earlier established patterns of structural change:

   a. the recession has its main impact on the production share of the investment goods sector. The 'normal' growth of the industrial sector is therefore squeezed. In general, however, sectoral trends have been affected only little.

   b. the absorption of a rent income from natural resources induces a relative decline of the traded-goods sector in favour of the nontraded-goods sector. The empirical results strongly support recently developed views with respect to the adjustment process following a boom in the extractive sector.

4. For the postwar OECD area as a whole the long-term process of industrialization still continues. The real production share of the manufacturing sector doesn't fall and parts of the service sector are being modernized rather quickly.

5. Since the normal pattern reflects the empirical impact of the general or universal factors, the role of the country-specific factors can be investigated by the introduction of dummy variables. When quantifying the differences between a country's actual and predicted development pattern, the (extended) model functions as a comparative measure, which enables us to classify countries according to their relative specialization. Further research in this context seems very fruitful especially when the normal pattern results are complemented and associated with those of other (more qualitative) international comparative studies.

6. The normal pattern can be considered as a reduced-form equation of a large dynamic multi-sector model. Apart from the traditional interpretation of the regression results considering the economic structure as the dependant variable, these results can perhaps also be helpful in dwelling upon a reverse mechanism.

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Summary

STRUCTURAL CHANGE IN OECD COUNTRIES: A NORMAL PATTERN ANALYSIS

This article discusses the development of sector shares against the background of growing *per capita* income and some other key variables. It elaborates on Chenery's normal pattern approach, which emphasizes the existence of regularities. Long-term dynamics in the economic structure are quantified. Conclusions are drawn with respect to the continuing process of industrialization, the role of the service sector and the rise or decline of manufacturing subsectors. The slow-down of overall growth rates and the discovery of energy resources are given special attention. Finally it is tried to detect some country-specific specialization patterns.